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AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

ACHIEVING AND ENSURING AIR DOMINANCE

by

Craig A. Hughes, Major, USAF

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Advisor: Mr. Matthew Caffrey

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Preface

This research paper advocates and explains air dominance. Air dominance goes beyond air superiority and supremacy in that it not only ensures that friendly aircraft can fly anywhere in enemy territory, but that they can also be *effective* at performing their mission. Suppression of ground-to-air attacks, prevention of attacks on our airbases, and overcoming domestic attacks on procurement are all important in ensuring the effectiveness, or dominance, of airpower. I chose this research topic because I had some experience with air dominance as a F-15C Eagle pilot from the Summer of 1989 to the Summer of 1992. I actively participated in Operations Desert Shield and Desert Storm with the 27th Tactical Fighter Squadron of the 1st Tactical Fighter Wing. I believe this research has particular value to the reader in that it reiterates the value of air dominance to the campaign planner, it reinforces that value through historical analysis, it closely examines the potential future threats (both foreign and domestic), then it proposes future courses of action. The goal is to ensure that the USAF's future air dominance requirements are being adequately addressed and that tomorrow's war fighters will continue to benefit from air dominance.

I acknowledge and sincerely thank my faculty research advisor, Mr. Matthew Caffrey, for the assistance, guidance, and motivation I received during this project.

Abstract

What the concepts of air superiority and supremacy lack is the consideration of the *effectiveness* of airpower to achieve objectives after an air force attains either. An enemy which has been defeated in the air may still prevent air dominance through a variety of means ranging from ground-to-air attacks to attacks on friendly airbases. The domestic procurement budget may also prevent air dominance due to a lack of understanding, hence funding, for any of the links of the air dominance chain. This research project develops an appreciation for air dominance by defining the issues and relevance, deriving tentative conclusions from a historical analysis, testing those conclusions in Operation Desert Storm while deriving additional tentative conclusions, analyzing the “thinking enemy” and their efforts to exploit gaps in air dominance, examining what budget shortfalls may be contributing to these gaps, and finally, discussing challenges and recommendations designed to determine the extent to which future air dominance requirements are being adequately addressed. In the end, the research paper will show the potentially grave error of under-funding a SEAD replacement and air base defense, and the danger of proposed future cuts to the F-22. Methodology includes an analysis of books, magazines, unclassified security assessments and threat estimates, and recently declassified publications from the Air Force Historical Research Agency.

Chapter 1

Air Dominance Refined

*If the enemy has air supremacy and makes full use of it, then one's own command is forced to suffer the following limitations and disadvantages: By using his strategic air force, the enemy can strangle one's supplies, especially if they have to be carried across the sea; The enemy can wage the battle of attrition from the air; Intensive exploitation by the enemy of his air superiority gives rise to far-reaching tactical limitations for one's own command.*¹

—Erwin Rommel

Today, Rommel's conclusion may be that the overall goal of a military commander should be to achieve and ensure all of the links of the air dominance chain. To fail to do so would exact a tremendous price. The ability to gain air dominance is crucial in the sense that it saves lives, affects the length of the conflict and the quality of the peace, as well as ensuring the accomplishment of national and military objectives.

Relevance and Statement of Thesis

This research is important because it connects the relevance of air dominance to the strategic application of the military instrument of power. According to the Air Force's *Global Engagement*, "if air dominance is achieved and joint forces can operate with impunity throughout the adversary's battle space, the Joint Force Commander will prevail quickly, efficiently and decisively.² Tentative conclusions, made after a historical analysis of air power, will be tested against Operation Desert Storm with the intent of

analyzing whether today's "thinking enemy," in conjunction with domestic budget decisions, are creating gaps in the state of air dominance. The analysis will reveal that America's ability to achieve air dominance is at risk.

Doctrine and Definition Differentiated

In military operations, the contribution of air dominance is overwhelming. Air dominance is not a given, but is earned as friendly forces move along a scale of airpower states over time (please reference Appendix A for Scale of Airpower States).

Air Denial

Friendly air forces may initially operate in a state of air denial at the start of the halt phase during which the enemy nearly has air dominance. While joint publications do not define air denial, for the purposes of this paper it is the lowest airpower state where friendly aircraft can conduct air operations sufficient enough to deny the enemy air dominance while conducting those airpower activities necessary to halt an initial enemy advance. The purpose in this state is the denial of enemy airpower *effectiveness*. The friendly ability, through its air defenses or airborne threats, to provide protection to friendly ground and air forces are abilities which decreases the *effectiveness* of enemy airpower. This concept was evident during previous conflicts. Enemy flak during the Korean War "did not prevent air operations but it did make them more expensive. Hostile fire and operations at increased altitudes to counter flak reduced bombing accuracy (thus *effectiveness*). The USAF estimated that dive-bombing accuracy declined from a 75-foot circular error probable in 1951 to 219 feet in 1953, which meant that more sorties were required to destroy a target."³ Despite air superiority at medium and high

altitudes during the Vietnam War, the United States lost to North Vietnam in part due to the condition of air denial in the low altitude environment with its surface to air missiles (SAMs) and antiaircraft artillery (AAA). The SA-2 SAM “did force the United States to devote considerable numbers of aircraft to defeat it...In many cases, the SA-2 forced aircraft to jettison ordnance in order to evade it, which in effect negated an aircraft’s mission (thus *effectiveness*).”⁴ The North Vietnamese also made promises for peace negotiations which resulted in dozens of bombing halts. History shows that these promises simply gave the North Vietnamese time to sustain and resupply their troops. The bottom line consideration is that it does not matter for what reason why an aircraft cannot drop its bombs (i.e. flak, SAMs, political moves, etc.), what matters is that the target is not attacked – or that the mission was *not effective*.

Air Superiority

The next airpower state is air superiority. *Air Force Basic Doctrine* notes that air superiority “rarely is an end in itself but is a means to the end of attaining military objectives.”⁵ Joint Pub 1-02 defines air superiority to be the degree “in the air battle of one force over another which permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force.”⁶ This state is not enough to ensure the *effectiveness* of airpower.

Air Supremacy

The next airpower state is air supremacy, which Joint Pub 1-02 defines as “that degree of air superiority wherein the opposing air force is incapable of effective interference.”⁷ Most theorists add that air supremacy is achieved when superiority is ensured just about everywhere, thus allowing friendly aircraft the ability to fly anywhere

within the theater of operations. However, this airpower state does not adequately address the issue of airpower's *effectiveness* at dropping bombs on enemy targets.

Air Dominance

The final airpower state is the attainment of *effectiveness* in the conduct of offensive air operations. While joint publications do not define air dominance, for the purposes of this paper it is the highest airpower state when the requisite *effectiveness* of airpower is achieved, that 100% of friendly bombs hit enemy targets while no enemy bombs hit friendly targets, that wars are won quickly (such as during the Six-Day War of 1967 and Operation Desert Storm of 1991), and that fewer friendly casualties are suffered.

The lack of air dominance may give the enemy time to use the “kill Americans” tactic. Killing Americans has become a time honored way of defeating the United States and has been used recently in Beirut and Somalia. General Charles A. Boyd, former deputy commander in chief of U. S. European Command noted that “fundamental to the whole issue...is a single question: ‘How many casualties is this nation really willing to absorb? My own feeling is, very few...I think their toleration of casualties is very, very low.’”⁸ Additionally, General John M. Loh, former head of Tactical Air Command, notes that the new standard is “to win quickly, decisively, with overwhelming advantage, and with few casualties. Congress and the public now expect U. S. forces to prevail by 99–1, not 55–54 in double overtime.”⁹ Potential adversaries fully understand this phenomena and exploit it. “The 1968 Tet offensive in Vietnam, the bombing of the Marine barracks in Beirut, and ‘Bloody Sunday’ in Mogadishu were all strategic events; yet none of them could be described as a major military defeat. Nevertheless, each of these events was a watershed in U. S. involvement and led to dramatic reverses in U. S.

policy.”¹⁰ Similarly, “the low attrition in Desert Storm seems to have established optimistic expectations about war, which may constrain future presidents and commanders.”¹¹ The implications of this tactic are numerous and very threatening. A lack of air dominance may allow the enemy to exact a tremendous death toll of American lives so that the U. S.’ resolve may weaken. The lack of air dominance will also make it significantly more costly for the military instrument of power to support *The National Security Strategy of the United States*. The NSS calls for the maintenance of superior military forces with the ability to rapidly defeat initial enemy advances short of enemy objectives in two theaters and in close succession. The *National Military Strategy* notes that the “successful application of military power is dependent on uninhabited access to air and sea...Our forces will seek to gain superiority in, and dominance of, these mediums to allow our forces freedom to conduct operations and to protect both military and commercial assets.”¹² These demands culminate in the *Quadrennial Defense Review* in which the “halt phase” requires a capability to rapidly defeat initial enemy advances in order to seize the initiative and minimize the loss of territory. Airpower proponents note that the halt phase is almost completely a mission for airpower—a mission which air dominance all but guarantees. A lack of air dominance will also make it more difficult and costly for the military instrument of power to conduct its growing role in deterrence and military operations other than war (MOOTW). Air occupation, or what some may refer to as air intervention, plays a key role in the military’s expanded role in MOOTW. Air dominance contributes to the safe accomplishment of these missions –thus success.

Campaign Success

This chapter's intent was to present an understanding of air dominance and to develop an appreciation for its importance in campaign success. Though air dominance was not quite achieved in Operation Desert Storm, air supremacy "proved again that a conventional ground war cannot be conducted once command of the air is conceded to the enemy...overall command of the air is a condition for taking and holding enemy territory."¹³ Additionally, airpower "yielded a swift and decisive victory for the coalition. Airpower was also the reason American casualties were far lower than in any previous conflict."¹⁴ The next chapter will analyze the role of air dominance from a historical perspective to attain tentative conclusions on its future role.

Notes

¹ Lt Col Charles M. Westenhoff, *Military Air Power: The CADRE Digest of Air Power Opinions and Thoughts* (Maxwell AFB, Ala.: Air University Press, 1990), 48.

² United States Air Force, *Global Engagement: A Vision for the 21st Century Air Force* (Washington, D. C.: Government Printing Office, 1997), 10.

³ Kenneth P. Werrell, *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense* (Maxwell AFB, Ala.: Air University Press, 1988), 74.

⁴ Lon O. Nordeen, Jr., *Air Warfare in the Missile Age* (Washington, D. C.: Smithsonian Institution Press, 1985), 40.

⁵ United States Air Force, *Air Force Basic Doctrine: Air Force Doctrine Document 1* (Washington, D. C.: Government Printing Office, 1997), 29.

⁶ Air Power Research Institute; College of Aerospace Doctrine, Research, and Education, *Essays on Air and Space Power, Volume II* (Maxwell AFB, Ala.: Air University Press, 1997), 153.

⁷ Ibid., 154.

⁸ James Kitfield, "To Halt an Enemy," *Air Force Magazine*, January 1998, 63.

⁹ James P. Coyne, *Airpower in the Gulf* (Virginia: Aerospace Education Foundation, 1992), 174.

¹⁰ David A. Shlapak and Alan Vick, *Check Six Begins on the Ground: Responding to the Evolving Ground Threat to U. S. Air Force Bases* (California: RAND, 1995), 19.

¹¹ Zalmay M. Khalilzad and David A. Ochmanek, *Strategy and Defense Planning for the 21st Century* (California: RAND, 1997), 172.

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¹² Joint Chiefs of Staff, *National Military Strategy of the United States of America: A Strategy of Flexible and Selective Engagement* (Washington, D. C.: Government Printing Office, 1995), 2.

¹³ Gary B. Hicks, *Joint Suppression of Enemy Air Defenses During Desert Storm: Implications For Future Campaign Support J-SEAD Operations* (Rhode Island: Naval War College, 1992), 16.

¹⁴ James P. Coyne, *Airpower in the Gulf* (Virginia: Aerospace Education Foundation, 1992), 177.

Chapter 2

Historical Analysis of Air Dominance

Our idea of air superiority is not that we win the fight like the RAF won the Battle of Britain, but that we win the fight in the other guy's airspace. In Korea, we fought the air superiority battle over the Yalu River. In Vietnam, we fought it over Hanoi. In Desert Storm, we fought it over Baghdad. So no American soldier presently serving in the Army has ever been attacked by an enemy airplane. It has been 40 years since we have had anybody come under enemy air attack. If you want to know what it is like to be attacked by an airplane, you have got to go talk to an Iraqi or a North Vietnamese or somebody else.¹

—General Merrill A. McPeak

Military theorists have long valued the study of history and its lessons learned as a means for preparing for the future. This chapter analyzes several mid to late twentieth century conflicts which have yielded significant examples of the role of airpower. Reference Appendix B for Aircraft Loss Causes - a graphical representation of attrition for the European and Pacific theaters of WWII - provided as a reference for analysis.

The Vietnam War

During the Vietnam War, airpower operated within an air defense system including “many radar sites to provide long-range early warning of approaching U. S. aircraft, to guide the SA-2 missile, to aim and fire the larger antiaircraft artillery pieces, and to be the eyes for the ground-controlled intercept network that vectored MiG interceptors into firing positions.”² Throughout Rolling Thunder (1964-1968), the SAM threat grew from

one battery in 1965 to approximately 40 batteries in 1968 when missile launches totaled between 590 to 740 per month. Between October 1967 and 1 April 1968, SAM firings averaged 220 per month and resulted in somewhere between 115 to 128 downed aircraft.

³ Throughout Linebacker I (May to October 1972), the North Vietnamese fired 2,750 SA-2s at U. S. aircraft and downed 46 planes. ⁴ During Linebacker II (December 1972) the North Vietnamese fired 1,285 SAMs which downed all 15 B-52s lost, as well as three other aircraft. ⁵ *Overall*, the aircraft attrition of the Vietnam war underscores the threat posed by ground based air defense systems to include AAA and SAMs which caused either the loss of friendly aircraft or the jettison of bombs in order to honor the threat (and therefore, a loss of *effectiveness*). Also, Communist MiGs, while only marginally effective, required U. S. packages to include air-to-air escort aircraft (resulting in fewer platforms available to carry bombs). Finally, this war saw the beginnings of precision guided munitions and the further development of suppression of enemy air defenses (SEAD) aircraft. The *net effect* was that the North Vietnamese were able to achieve some measure of air denial despite the American's air superiority (reference Appendix B for a graphic depiction of USAF aircraft losses by cause during Vietnam).

Indian-Pakistani Wars

During the Battle For Kashmir (Indo-Pakistan Conflict, 1965), one source notes that Pakistan claimed to have destroyed 113 aircraft while India reported that it had destroyed 73 aircraft, and both sides made frequent attacks on each other's airfields. ⁶ A second source notes that the Pakistanis claim to have destroyed 110 Indian aircraft – 35 in air-to-air combat, 32 by antiaircraft guns, and the rest in attacks on airfields, while admitting to losing 19 aircraft, eight in air combat, two to their own AAA, and nine to other causes. ⁷

In the Indo-Pakistani War (1971), one source indicates that India stated that it destroyed 94 Pakistani aircraft while losing only 54. Pakistan claimed to have destroyed 106 Indian aircraft while admitting to losing only 25 planes, but other sources claimed 40 aircraft from all causes.⁸ A second source adds that the Pakistanis assert that 49 of their 104 kills were registered by AAA. Another source states that half of the lost Pakistani aircraft fell to ground defenses.⁹ *Overall*, these wars emphasize the inherent strength in a strategy to achieve air dominance by attacking enemy airfields and destroying aircraft on the ground. The 1965 conflict emphasizes the indecisive result of war when both sides basically have air superiority over their own territories. The 1971 conflict emphasizes the speed of war when air dominance is achieved quickly (reference Appendix B for a graphic depiction of the 1965 Indo Pakistan War aircraft losses by cause).

Arab-Israeli Conflicts

During the Six-Day War (1967) Israel struck the first blow by staging a surprise attack against 10 Egyptian airfields during which Israel claimed to have destroyed 451 aircraft during the first 60 hours, 58 of them in air combat. One source indicated that Israel lost about 45 aircraft, at least three-quarters of them to antiaircraft fire.¹⁰ During the War of Attrition (1967-1970) Israel reportedly shot down 137 Arab aircraft while Syria, Egypt, and guerrilla groups claimed to have downed more than 250 Israeli aircraft.¹¹ Another source notes that Israel further claimed at least 35 aircraft with antiaircraft fire and ground-launched U. S.-built Hawk missiles, and admits to losing 22 aircraft to SAMs and AAA. Egypt, Syria, Jordan, and Arab guerrilla groups claim a tally of more than 300 Israeli aircraft.¹² During the Yom Kippur War (1973) over 500 aircraft were destroyed to include more than 370 Egyptian, Syrian, and Iraqi fighters, one Tu-16

bomber, and some 40 Arab helicopters felled by the guns and missiles of Israeli fighters in dogfights, for the loss of only four Israeli fighters. Overall, Israel lost 115 aircraft to include four fighters in air combat, another one shot down accidentally by an Israeli fighter, 10 by accidents or unknown causes, 48 by surface-to-air missiles, and 52 by antiaircraft fire. U. S. intelligence sources estimated that Arab missiles and antiaircraft artillery claimed 80 percent of the Israeli aircraft shot down, air combat 10 percent.¹³ During the conflict in the Beka'a Valley (1982), Israeli aircraft attacked Syrian SA-6 SAMs with great success. *Overall*, the various Arab-Israeli conflicts illustrate the success of attack of airfields and aircraft on the ground. Additionally, Arab forces were well armed with a wide assortment of Soviet equipment to include the four-barrel 23-mm ZSU-23-4, and the SA-2, SA-3, SA-6 and SA-7.¹⁴ *Overall*, these conflicts demonstrated the growing complexity of the battlefield amongst airpower forces using a variety of systems to include unmanned decoys, ground- and air-launched anti-radiation missiles, cluster munitions, and conventional high-explosive bombs to attain and ensure air dominance.¹⁵ Please reference Appendix B for a graphic depiction of the 1973 Yom Kippur War Israeli and Arab aircraft losses by cause.

Battle for Malvinas: Falklands Islands Conflict

During the 1982 conflict, Argentina admitted losing 79 aircraft, 49 said to have been destroyed in combat. Meanwhile, Britain claims that it destroyed or captured 103 Argentine aircraft while losing nine.¹⁶ *Overall*, this war emphasized the lethality of the control for air superiority amongst symmetric forces. It also involved the total spectrum of attrition, to include destruction of aircraft while on the ground, by ground fire (both AAA and SAMs), and air to air combat. Finally, it demonstrated the continued need for

long range air dominance assets (reference Appendix B for a graphic depiction of the Falkland War's Argentine and British aircraft losses by cause).

Tentative Conclusions

Based upon this historical analysis, several conclusions about the state of air dominance are demonstrated. *First*, adversaries will utilize whatever methods are available to prevent their enemy from achieving air dominance. *Second*, adversaries will utilize whatever methods are available to ensure their own achievement of air dominance. *Third*, adversaries will use both airborne and ground-based resources to meet these two objectives. *Fourth*, the side with the best employment of available technology will have a better chance to achieve their airpower objectives. *Fifth*, even the achievement of air supremacy does not guarantee total effectiveness of the application of airpower. *Sixth*, the mere existence of a threat will require that resources at least be available to deal with it (for example, if an adversary has interceptor aircraft, friendly forces must send fighter escort with bombers to deter or defeat that threat). *Seventh*, the importance of SEAD assets, precision guided munitions, and others (such as space assets and unmanned vehicles) have increased. *Eighth*, attacks on airbases and flight personnel has increased in importance as adversaries find it is cheaper and easier to accomplish these attacks. *Ninth*, wars tend to be fast when there is air dominance (i.e. Six-Day War of 1967) and slow when there is some state of air denial, and subsequently no air dominance (i.e. Vietnam). Finally, *tenth*, conflicts between symmetric forces are extremely lethal and costly. In the next chapter, these tentative conclusions will be analyzed within the context of Operation Desert Storm to determine whether additional air dominance conclusions can be made.

Notes

¹ Merrill A. McPeak, *Selected Works 1990-1994* (Maxwell AFB, Ala.: Air University Press, 1995), 141.

² Lon O. Nordeen, Jr., *Air Warfare in the Missile Age* (Washington, D. C.: Smithsonian Institution Press, 1985), 9 & 39.

³ Kenneth P. Werrell, *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense* (Maxwell AFB, Ala.: Air University Press, 1988), 107.

⁴ Ibid., 116.

⁵ Ibid., 125.

⁶ Nordeen, 90.

⁷ Werrell, 150.

⁸ Nordeen, 103.

⁹ Werrell, 151.

¹⁰ Nordeen, 111 & 116.

¹¹ Ibid., 124.

¹² Ibid., 141.

¹³ Ibid., 163.

¹⁴ Werrell, 140.

¹⁵ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume II, Operations, and Effects and Effectiveness* (Washington, D. C.: Government Printing Office, 1993), 69.

¹⁶ Nordeen, 201.

Chapter 3

The Persian Gulf War

In Desert Storm...[we] had air dominance. That air dominance allowed our strike aircraft to devastate the enemy air forces, and, at the same time, allowed our ground forces to operate without any [enemy] air interdiction. Desert Storm taught us something about air dominance. We had it, we liked it, and we're going to keep it.”¹

—Secretary of Defense William Perry

While the role of airpower in the Persian Gulf War will always have both its critics and proponents, the bottom line “is evident in the hundreds of Coalition aircraft that flew combat missions each day without being lost or damaged by hostile action, as well in the near absence of Iraqi attacks...the Coalition’s efforts to gain early control of the air would appear to have been highly effective by virtually any historical standard.”² As proposed earlier, the question may be more of whether the Coalition had indeed achieved air dominance as defined earlier in terms of the *effectiveness* of the airpower operations.

The Air Campaign

Overall, the air campaign flew a wide variety of aerial missions to include Counter Air Patrol (CAP) [Offensive Counter Air (OCA) and Defensive Counter Air (DCA)], Suppression of Enemy Air Defenses (SEAD), Air Interdiction (AI), Combat Air Support (CAS), Tactical Surveillance and Reconnaissance, and Specialized Tasks (Electronic Combat, Special Operations, and Combat Search and Rescue). Air superiority targets

included airfields, aircraft, air warning sites, threat radars, and air control and direction facilities. In the end, 69,406 total sorties were flown by the U. S. Air Force to include 4,097 DCA, 461 CAP, 2,490 OCA, 3,045 SEAD, and 887 Escort.³ Please reference Appendix C for Desert Storm Coalition Air Dominance Assets and Tasks.

Please reference Appendix D for CENTAF's theater objectives. Of particular note is objective two (Gain and maintain air superiority) which indicates the CENTAF and USCENTCOM commander's emphasis on the importance of this necessity for success.

Please reference Appendix D for phasing specifics. Of particular note was the importance placed on Phase II: KTO SEAD Operations. Planners recognized the importance of the SEAD campaign in allowing the air forces to conduct "relatively uninhibited attacks on targets within the KTO" - a requisite for remaining phases.⁴

Air Tasking Order (ATO) analysis indicates that out of a total of 48,478 targeted missions, 3,748 sorties were devoted to OCA. An additional 1,378 targeted missions were devoted to command, control, and communications targets, 945 for lines of communication targets, and 5,161 for SAM sites, equipment and facilities (not including F-4G Wild Weasel missions devoted specifically to SEAD).⁵ Specifically, "OCA targets included airfields (airbases, reserve fields, helicopter bases), non communications electronic installations (radar installations, radars collocated with SAM sites, ATC/Nav aids, meteorological radars), air logistics, air depots, air ammo depots (maintenance and repair bases, aircraft and components production and assembly). SAM targets included support facilities, defensive, general; SAM sites/complexes; tactical SAM sites/installations; and SAM support facilities."⁶ Primarily as a result of lessons learned during the Iran-Iraq War, Iraq invested significantly in its KARI air defense system it had

purchased from France (KARI is Iraq spelled backwards in French). KARI was able to fully integrate the air defense systems that Iraq had acquired from a variety of sources. “Coalition planning to suppress Iraq’s radar-guided SAMs consisted of two main thrusts. The first was to attack KARI physically. The second thrust focused on the active suppression of Iraq’s radar-guided surface-to-air missiles using drones and large numbers of anti-radiation missiles (principally the HARM high-speed anti-radiation missile) from Wild Weasel F-4Gs, F/A-18s, and other aircraft.”⁷ SEAD assets were an integral part of practically every package of attack aircraft inbound to Iraqi centers of gravity as “the Weasels and Ravens supported shooters as they attacked their targets in Iraq and the Kuwaiti Theater of Operations (KTO). One sign of their success was that after day four, all allied aircraft operated with impunity in the mid to high altitude environment across the AOR. By decreasing the threat of SAMs to our strike aircraft, EF-111s and F-4Gs permitted aircraft to deliver their weapons from an environment where they can be very lethal.”⁸ As a result, “Saddam’s central control of his air defense system was fatally damaged, forcing the Iraqi defenders to depend on barrage antiaircraft fire and uncontrolled missile launches.”⁹ One of the world’s most advanced air defense systems was blinded by the coordinated effort of each link of the air dominance chain.

Iraqi Air Order of Battle

The numbers and varieties of assets in place in Iraq prior to the Persian Gulf War were impressive (reference Appendix E for Desert Storm Iraqi Antiaircraft Weapons). On the first of January 1991, the Iraqi Air Order of Battle included 728 fighter/fighter-bombers, 15 bombers, 7,600 air defense artillery, and 120 SAM batteries.¹⁰ Please reference Appendix F for Desert Storm Iraqi Air Order of Battle.

Aircraft Attrition Analysis

A total of 41 Iraqi aircraft were destroyed in the air and their fate is detailed in Appendix G. Despite the multitude of sorties flown by the coalition against Iraq, as compared to the few sorties flown by the Iraqi Air Force, a total of 38 coalition aircraft were lost and an additional 48 were damaged during combat operations (reference Appendix G). Overall, for the U. S. Air Force, aircraft combat attrition rates for its 37,567 combat sorties flown were 0.7 damaged and 0.4 lost aircraft per 1,000 sorties.¹¹

Tentative Conclusions Revisited

Operation Desert Storm certainly supported last chapter's tentative conclusions. The Iraqis used SAMs and AAA fairly effectively to prevent the achievement of air dominance by Coalition forces (tentative conclusion #1). While the Iraqis did not make a significant attempt to achieve their own air dominance (#2), they did use both ground and air assets to deny Coalition air dominance (#3) (note in Appendix G that one Coalition aircraft was downed by an Iraqi MiG). The technology used by the Coalition was clearly superior and more highly advanced, and this contributed to success on the battlefield (#4). Despite Coalition air supremacy, the fact that F-16 aircraft losses were so high that a 10,000 foot floor was established resulting in poor bombing accuracy (none to few F-16s could carry precision guided munitions) proved that Coalition aircraft were not totally effective (#5). The Iraqi "fleet in being" in Iraq and Iran forced Coalition packages to include air superiority assets for escort or forced multi-role fighters to devote some of their bomb carrying capacity to air to air weaponry (#6). Based purely on the sheer numbers of F-4G SEAD sorties flown and the multitude of precision weapons used by the F-111, F-15E, and F-117, these abilities are increasingly important (#7). The negative

effect on airfield operations and personnel deaths caused by SCUD firings increased and resulted in the reapplication of airpower assets to deal with the threat (#8). Coalition airpower had air supremacy and few would doubt this contributed to the short duration of the war, especially compared to the length of WWII, or the Korean or Vietnam War (#9). Finally, the quantity of lives lost and extent of destruction demonstrates that today's conflicts are still extremely lethal and costly (#10).

New Tentative Conclusions

Operation Desert Storm has provided several significant additional conclusions about the critical role of air dominance. *First*, the Iraqi military made excellent use of its long range artillery against Kuwaiti airfields during the initial attack from within its own borders. This certainly gives additional significance to an army's ability to achieve air denial or deny air dominance. *Second*, the significance of the "information attack" by the Coalition was critical in its ability to deny the Iraqis an ability to deny Coalition air dominance. *Third*, the role played by precision guided munitions was instrumental in several regards. It took away the sanctity of hardened shelters in which the Iraqis had invested heavily. It permitted some aircraft to deliver its bombs from a safer altitude and longer slant range which kept aircraft away from small arms fire and hand held SAMs (thus denying the enemy the use of one of the more traditional methods of air denial). *Fourth*, the role played by SEAD aircraft, especially the F-4G, was desperately needed. The effort was significant simply in terms of sorties flown and HARMs expended. In terms of minimizing the role played by Iraqi SAMs, SEAD aircraft allowed for more effective mission accomplishment. *Fifth*, the continuing presence and sophistication of world media makes it even more important that air dominance, quickly followed by

mission accomplishment, be timely and with as few as casualties as possible. *Sixth*, even a country like Iraq, with little indigenous advanced military technology, was capable of obtaining desired technologies easily from more advanced countries such as France and Russia. Finally, *seventh*, the decision to move Patriot missile systems into the region earlier than originally planned (the result of war gaming lessons learned) most likely contributed to significant deterrent effects during Operation Desert Shield and most likely prevented SCUD attacks from destroying air dominance assets on the ground during Operation Desert Storm. *Overall*, Operation Desert Storm showed that any combination of hardened shelters, advanced aircraft, and heavily integrated air defenses, are penetrable *if* there is a weakness in the system which can be found and exploited. Certainly, other potential adversaries who observed Operation Desert Storm both observed and learned this lesson, the result of which is discussed in the next chapter.

Notes

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³ *Ibid.*, 232.

⁴ Lt Col Jerome V. Martin, *Victory From Above: Air Power Theory and the Conduct of Operations Desert Shield and Desert Storm* (Maxwell AFB, Ala.: Air University Press, 1994), 56-57.

⁵ Cohen, *Volume V*, 226.

⁶ *Ibid.*, 414.

⁷ Cohen, *Volume II*, 135.

⁸ United States Air Force, *Air Force Performance in Desert Storm* (Washington, D. C.: Government Printing Office, 1991), 5.

⁹ James P. Coyne, *Airpower in the Gulf* (Virginia: Aerospace Education Foundation, 1992), 11.

¹⁰ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume V, A Statistical Compendium and Chronology* (Washington, D. C.: Government Printing Office, 1993), 18-19.

¹¹ Cohen, *Volume V*, 651.

Chapter 4

Adversarial Threat and Procurement Vulnerabilities

In order to assure an adequate national defense, it is necessary—and sufficient—to be in a position in case of war to conquer the command of the air.¹

—Giulio Douhet

The contest for air superiority is the most important contest of all, for no other operations can be sustained if this battle is lost. To win it, we must have the best equipment, the best tactics, the freedom to use them, and the best pilots.²

—General William W. Momyer

A potential enemy will also observe the history of air dominance and reach similar conclusions. That enemy will analyze friendly and enemy centers of gravity, and will attempt to develop ways to protect friendly forces and attack their enemy's vulnerabilities. The *QDR* expects the enemy to "employ asymmetric means to delay or deny U. S. access to critical facilities; disrupt our command, control, communications, and intelligence networks; deter allies and potential coalition partners from supporting U. S. intervention; or inflict higher than expected casualties in an attempt to weaken our national resolve."³ The following analysis of the "thinking enemy" and procurement vulnerabilities reveal potential gaps in, and risks to, the air dominance chain.

The “Thinking Enemy”

Over time, the enemy has exhibited an uncanny ability to look for gaps, find vulnerabilities, and exploit their enemy’s critical centers of gravity. For example, the “1981 Israeli attack on the Osirik nuclear reactor...underlined Iraq’s vulnerability to air attack...The result was that Iraq devoted considerable resources to build up its air defenses and to purchase up-to-date fighter aircraft.”⁴ More recently, during Operation Desert Storm, after ground observers would call inbound coalition raids, Iraqi Roland or SA-8 radars would be used for short fifteen-second burst to determine the altitude of inbound aircraft so that antiaircraft artillery could more accurately set their fuses.⁵ Coalition forces also noted that “after the war began, the Iraqis used decoys and simulations to deceive and foil coalition attacks. One method they used was to park the (SCUD) missile system under a highway viaduct. They could pull the missile out, launch it, and then return the transporter-erector-launcher to the safety of the viaduct in less than five minutes – less time than coalition aircraft needed to target the position.”⁶ It would be naïve to think that Iraq was the only future adversary to learn from Iraqi mistakes. Many other potential adversaries gained valuable insight for future conflicts. As one Defense Department official articulated, “Historically, the people who win usually don’t learn nearly as much as the people who lost or the people who watched.”⁷ A “thinking enemy” searches for, finds, and attacks any air dominance gaps or vulnerabilities.

Potential Adversary Military Expenditures

Russia, China, and Iran are “thinking enemies” with uncertain futures. The *QDR* notes that Russia and China present a future challenge as a regional great power or global peer competitor. Iran is noted due to its proximity to the volatile Persian Gulf and its

current political relations with the U. S. Please reference Appendix H for Military Expenditures Statistics.

Russia

As the world's largest and most potent conventional armed force, Russia is not a potential adversary to take lightly and which has serious military concerns about the shifting balance of forces in Europe.⁸ Please reference Appendix I for Russia's Inventory Fixed Wing Assets, and Appendix J for Russia's Inventory Air Defense Systems. Russia has been one of the most illusive of the world's powers for releasing information about its procurement trends. Please reference Appendix K for Russian's Air Dominance Procurement Trends. Overall, Russia continues to develop its superior technology arms, and its need for currency will add to continued proliferation.

China

The strength of the Chinese economy combined with its political ambitions mix to make China a power to be watched. Its arms-exports policies are a concern regarding weapon-of-mass-destruction proliferation, and the supply of conventional and light weapons to the world's belligerents.⁹ Please reference Appendix L for Chinese Inventory Fixed Wing Assets, Appendix M for Chinese Inventory Air Defense Systems, and Appendix N for China's Air Dominance Procurement Trends. Overall, China has undertaken significant upgrades for high-technology warfare.

Iran

Several regional development have enticed Iran to strengthen its strategic power to advance its own national strategic interests. Please reference Appendix O for Iran's

Inventory Fixed Wing Assets, Appendix P for Iran's Inventory Air Defense Systems, and Appendix Q for Iran's Air Dominance Procurement Trends. Overall, Iran has been very active with its research and development programs. Iran has also devoted significant priority to its air arm, weapons of mass destruction, and missile capabilities by buying front-line attack aircraft from Russia, and coastal defense systems and surface-to-surface missiles from China and North Korea.¹⁰

Observations - Denial of Air Dominance

This analysis indicates increasing emphasis being placed on the ability to locate a gap or vulnerability in the U. S.' air dominance capability and exploiting it.

Airborne and Ground-to-Air Threats

The continued procurement of SAMs and air superiority aircraft by potential adversaries will require the that the U. S. also plan to meet and defeat that threat. Failing to do so will enable the enemy to exact virtual attrition. Virtual attrition refers to the enemy's ability to decrease friendly effectiveness of bombing while not actually shooting down bomber/attack aircraft. For example, during the Vietnam War, the North Vietnamese Air Force always had at least a small number of aircraft available for MiG combat air patrol. As a result, friendly packages had to include MiG cover air superiority aircraft to protect friendly bomber/attack aircraft. A package of 20 aircraft might only have eight to 12 actual bomber/attack aircraft. On packages where escort aircraft were not available, a common MiG tactic was to jump the package thereby forcing some, if not all aircraft to jettison their bombs. The result was a lack of bombing *effectiveness*. When the SAM threat was not attacked, multiple SAM launches would have the same effect.

Even though U. S. airpower had air superiority, not all missions were *effective* since bombs often missed their targets. In response to the development of the F-22, potential adversaries may realize that they might not be able to defeat the F-22 in pure air to air battle. However, if sufficient F-22s are not available for escort, which may be the case pending additional cuts in F-22 procurement, then the enemy may use virtual attrition tactics while “killing Americans.” Both the *QDR* and *National Defense Panel (NDP)* recognize the importance of the F-22 in terms of both its air superiority and substantial air-to-ground capability – yet the procurement numbers are being cut further. The fact that potential adversaries may try other techniques to counter the F-22 doesn’t take away from its necessity on the battlefield.

Losses on the Ground

Aircraft damage, and thereby loss of *effectiveness*, can result from standoff weapons, ground penetrating attacks, truck bomb style attacks, air attack to airbases, and NBC attacks. Several of these types of attack have historical precedence and are most likely to continue in the future. One study found that “between 1940 and 1992, ground attacks on air bases occurred at least 645 times in 10 separate conflicts, destroying or damaging over 2,000 aircraft in locations worldwide. Attacking groups have run the gamut from regular armored columns to terrorist groups; from troops assaulting across land to amphibious forces coming by sea; to airborne forces arriving by parachute, glider, and aircraft; to, finally, special forces, sappers (military engineers who specialize in constructing field fortifications or laying minefields), guerrillas, and terrorists, making their contribution by any or all of the above means.”¹¹ Please reference Appendix R for Airbase Ground Attack Study Findings. Dominance of U. S. airpower may motivate the enemy to employ

an asymmetric strategy (best done with airborne and special forces) in which an adversary will use new and cheap technologies such as precision munitions for mortars, large-caliber sniper rifles, antitank weapons, fiber-optic guided missiles, man-portable SAMs, and remotely piloted vehicles. If friendly forces are not adequately prepared for these types of attacks then the enemy will find gaps and exploit them. The earlier procurement analysis indicates that significant special forces and airbase attack resources are being developed by potential adversaries to do just that. Please reference Appendix S for Airborne/Special Forces Units of Sample Countries (including Iran, Libya, and North Korea). A recent example was the use of SCUDs by Iraq during Operation Desert Storm to attack coalition airfields. Inbound and unimpeded SCUDs have the potential to destroy aircraft, and at a minimum decrease *effectiveness* by slowing the tempo of ground operations (such as refueling and rearmament).

U. S. Procurement and Vulnerabilities

The issue of military asset procurement is certainly a point of popular debate. Tied to this debate is the determination of the direction the military will take in terms of its roles, missions, and tasks, and to what extend the Congress and the President is willing to fund it. This determination will manifest itself in terms of how capable the military will be. According to the late, then chairman of the House Armed Services Committee, Rep. Les Aspin (D-Wis), “the U. S. military was not as bad as it looked at Desert One, and is probably not as good as it looks after Desert Storm.”¹² More recently, both the *QDR* and the *NDP* recommended that air dominance be considered with utmost importance, but procurement proposals do not concur with these recommendations and needs.

Budget Proposal Analysis and Shortfalls

The procurement of the right types and right numbers of links to the air dominance chain comes down to budget proposal priorities. Unfortunately, the picture is not entirely clear as “the administration itself, in figures now widely publicized, estimates that ‘recapitalization’ and modernization will require \$60 billion per year in procurement dollars of today’s purchasing power. Yet procurement requests in the president’s budget have been struggling to stay above \$40 billion, and even the recent substantial congressional additions have left the procurement account well short of the mark.”¹³ Please reference Appendix T for Top 20 USAF Acquisition Programs for Fiscal Years 1997 – 2003, and Appendix U for Major US Air Dominance Weapon Systems on Order/Upgrade, FY 1998-2003. A comparison between current assets, budgeting procurement, and the potential enemy threat indicates some shortfalls, or the potential to become so. According to Retired Maj. Gen. Charles D. Link, former special assistant to the Air Force Chief of Staff for the National Defense Review and the *QDR*, “...it was a step in the right direction that the *QDR* called for airpower to achieve a halt in the advance of enemy armored forces...It has yet to be matched, however, with commensurate changes in resources, warfighting plans, or doctrine.”¹⁴ Others have added that “arguments for major changes in warfighting strategy and shifts in the service budgets to reflect the greater capability of airpower have met stiff resistance. The problem, is that such arguments run up against a Pentagon culture which values consensus and an emphasis on joint operations above nearly all else.”¹⁵ The above appendices indicate a gap in the “proper” amount of procurement dollars devoted to SEAD and airbase defense assets, as well as a genuine concern that the procurement of the F-22 will continue to be cut.

SEAD: F-4G vs. F-16WW

The first of the shortfalls is the procurement of adequate SEAD assets. Without a doubt, the necessity for quality SEAD assets proved itself during Operation Desert Storm, and the F-4G Wild Weasel was “an aircraft equipped to destroy, neutralize, or degrade enemy radar-directed surface-to-air threats. The F-4G Wild Weasel aircraft was specially modified to carry the AN-APR-47 Radar Attack and Warning System, which detects, identifies, and locates pulsed and continuous wave radar emitters. Although the F-4G could carry virtually every type of air-to-air and air-to-surface munitions, the preferred SEAD ordnance in the Gulf War was the AGM-88 (HARM). The F-4G was the weapon system of choice when it came to destroying Iraqi SAM sites.”¹⁶ However, the destiny of the F-4G was already written into budget cut proposals well before it proved its invaluable contribution during Operation Desert Storm. In the interim, now that the F-4G has been retired without plans for a dedicated replacement, “the F-16 will be equipped with a more generic and less-capable system that utilizes the HARM seeker head to find and identify threats, but the system does not provide a ranging capability...the SEAD mission demands a capable aircraft – an aircraft able to employ suppression munitions at their full capability, not in some degraded mode.”¹⁷ Despite these conclusions, neither the U. S. Air Force budgets nor its planned procurements (as shown in Appendices T and U) includes any quality replacement for the Wild Weasel capability. During Operation Desert Storm, the F-4G flew 2,683 SEAD sorties and the F-16, the widely flown fighter of the war, flew 13,087 all-purpose sorties.¹⁸ Which aircraft will take up the role of the F-4G Wild Weasel? A worse case may be that the F-16 Wild Weasel, a significantly less capable aircraft in the SEAD role, will dedicate sorties for SEAD without there being plans to make up for the needed F-16 sorties which were previously dedicated to

battlefield interdiction and close air support. The military planner simply does not have an adequate inventory of SEAD assets. Jammers have also consistently lost in the procurement battle and are both aging and in short supply. During Operation Desert Storm, *all* SEAD aircraft were utilized to support only 25% of the combat inventory. The success of the F-117 stealth fighter does not eliminate the need for jammers and SEAD support aircraft since it is unlikely that the entire bomber/attack/support force will ever have the same stealthy capabilities, aside from the fact that weaponry may further develop to challenge the advances of stealth technology.¹⁹ Potential adversaries have recognized this vulnerability, or gap, and plan to exploit it.

Air Base Defense

The second of the shortfalls is the procurement of adequate air base defense. Given the necessity of air superiority, “secure bases are a prerequisite for airpower operations; ensuring that they are available should therefore be a primary responsibility of USAF leadership.”²⁰ The *QDR* has set a dangerous precedence by questioning, and deciding to significantly slow and cut, the procurement of a collection of U. S. ballistic missile defense programs to include the Army’s Patriot PAC-3, the Navy’s Area Theater Missile Defense, the Coalition’s Medium Extended Air Defense System, the Army’s Theater High Altitude Area Defense System, and the Air Force’s Airborne Laser. Budget cuts have taken its toll as the 1998 ballistic missile defense programs budget request is down 13% from 1997 authorizations.²¹ What the Air Force has done for ground based air defense systems is to study it through the creation of a force protection battle laboratory – though the combat assets to actually perform the mission are insufficient. Again, a lack of procurement has created potential gaps which the enemy has found and will exploit.

F-22 Raptor

The third, and final of the identified potential shortfalls is procurement of the F-22 Raptor. The *QDR* has, on one hand, emphasized the F-22's importance as a tactical aircraft program, and “assessed alternatives to these programs from the standpoint of both warfighting risk and acquisition cost. Termination...was not considered prudent given the warfighting risk of such a decision and the significant adverse impact it would have on technology development and the defense industrial base.”²² On the other hand, the *QDR* significantly degraded the capability of the program when it cut the number of F-22 procurements from 438 to 339.²³ Further, proponents of further cuts to the defense budget may seek other ways to degrade, or eliminate the F-22. At a recent conference, “Lockheed Martin, mindful of alternatives to the F-22, took aim at the notion of sprucing up the current F-15 and continuing to use it as USAF’s prime air superiority fighter. The company insisted that any new F-15 derivative would entail 90 percent of the F-22’s cost but deliver only one-third of its aerial combat effectiveness.”²⁴ The continuing debate on budget allocation and lucrative defense contracts has significantly threatened the capability of the Air Force to provide the air dominance needed for battlefield victory. The F-22 serves as the counter to virtual attrition while providing combat capability needed to provide air dominance should, and when, deterrence fails. Should the F-22 be cancelled, or planned procurements further reduced, U. S. airpower may find itself significantly behind to counter such Russian development as the MiG-29M and the MiG MAPO aircraft. Such a gap could be a serious shortfall in air dominance capabilities which the enemy has demonstrated an intention to exploit.

Notes

¹ Robert Debs Heinl, Jr., *Dictionary of Military and Naval Quotations* (Annapolis: United States Naval Institute, 1966), 6.

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³ William S. Cohen, *Secretary of Defense: Report of the Quadrennial Defense Review* (Washington, D. C.: Government Printing Office, 1997), 4.

⁴ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume II, Operations, and Effects and Effectiveness* (Washington, D. C.: Government Printing Office, 1993), 71.

⁵ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume IV, Weapons, Tactics, and Training, and Space Operations* (Washington, D. C.: Government Printing Office, 1993), 32.

⁶ *Ibid.*, 33-34.

⁷ Gary B. Hicks, *Joint Suppression of Enemy Air Defenses During Desert Storm: Implications For Future Campaign Support J-SEAD Operations* (Rhode Island: Naval War College, 1992), 13.

⁸ Jane's Information Group, *Jane's Sentinel, Russia and the CIS, 1996 Edition* (United Kingdom: Sentinel House, 1996), 8.0.3.

⁹ The International Institute for Strategic Studies, *The Military Balance: 1997/98* (London: Oxford University Press, 1997), 167.

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¹² James P. Coyne, *Airpower in the Gulf* (Virginia: Aerospace Education Foundation, 1992), 175.

¹³ Zalmay M. Khalilzad and David A. Ochmanek, *Strategy and Defense Planning for the 21st Century* (California: RAND, 1997), 264.

¹⁴ James Kitfield, "To Halt an Enemy," *Air Force Magazine*, January 1998, 62.

¹⁵ *Ibid.*

¹⁶ Cohen, *Volume IV*, 91-92.

¹⁷ Major William Hewitt, *Planting the Seeds of SEAD: The Wild Weasel in Vietnam* (Maxwell AFB, Ala.: Air University Press, 1993), 24-25.

¹⁸ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume V, A Statistical Compendium and Chronology* (Washington, D. C.: Government Printing Office, 1993), 316.

¹⁹ Les Aspin and William Dickinson, *Defense For a New Era: Lessons of the Persian Gulf War* (Washington, D. C.: Government Printing Office, 1992), 37.

²⁰ Shlapak, 77.

²¹ The International Institute for Strategic Studies, 15.

²² Cohen, *Secretary of Defense*, 45.

²³ *Ibid.*, vii.

²⁴ Peter Grier, "Aerospace Technology Exposition," *Air Force Magazine*, November 1997, 79.

Chapter 5

Air Dominance Revalidated

The most unjust war, if supported by the greatest force, always succeeds; hence the most just ones, when supported only by their justice, as often fail.¹

—St. John de Crevecoeur

And so it is certain that a small country cannot contend with a great, that few cannot contend with many, that the weak cannot contend with the strong.²

—Mencius

The previous chapters have analyzed the purpose, history, threats, procurement, and vulnerabilities to the achievement and ability to ensure air dominance, with the overall purpose of increasing awareness of its fragile nature under current procurement plans.

Revalidation

The major role of air dominance in the achievement of campaign success is without question. It was shown on again on January 29th, 1991 at the Battle of Khafji during Desert Storm in which Iraq launched its only offensive of the Gulf War: “Khafji demonstrated to all but the most ingrained skeptic the ability of deep air attacks to shape and control the battle and yield advantages for engaged ground forces. In 1991, airpower identified, attacked, and halted division-sized mechanized forces without the need for a synchronized, ground counterattack. The conclusion, for some, is that the US should put

more emphasis on airpower and less on ground forces. Again, even more recently, the Air Force's role in Bosnia is an example of the primary role played by airpower during MOOTW. From August 30 to September 14, 1995, "a three-week campaign – called Deliberate Force – was launched...it was dominated by airpower, the weight of which hammered the Bosnian Serb heavy weapons, ammunition depots, command-and-control bunkers, and other targets. At the same time, NATO air forces undertook a parallel operation called Dead Eye, which took down the Serbian Soviet-style air defense network."³ The ability to conduct these operations must be ensured. Whether the mission is the *QDR*'s Halt Phase, Force-In-Being, or Air Occupation, the attainment of air dominance combined with SEAD and jammers will give coalition aircraft the ability to operate in the medium and high altitude environments with impunity. This fact, combined with precision guided munitions, will enable aircraft to stay clear of the low altitude environment and thus stay clear of AAA, and other man-portable, mobile, or fixed SAMs. Also important, "JSTARS and AWACS serve as 'force multipliers' in the course of individual engagements by enhancing the accuracy (and thus lethality) of munitions."⁴ The ability to ensure air dominance also reduces friendly attrition.

Challenges

The changing strategic assessment and the situation that downsizing has created will create significant challenges for the United States. If the U. S. desires to remain as a stabilizer of relations amongst the world's major powers, it must both persuade Russia and China to follow a policy of cooperative participation while dissuading them from settling disputes by force.⁵ An ability to exact air dominance can both persuade and dissuade. The U. S. will also be challenged to compensate for previous and current

procurement cuts. Earlier procurement curtailments have created a situation in which “downsizing of the force that began in 1990 cloaked the decline in recapitalization because, as the Department of Defense trimmed force levels, the older equipment went first, leaving the remaining forces with what was relatively new. But the decline in procurement slipped below the level needed to continue to keep new equipment in the force in the future. As a result, each military service needs a recapitalization funding surge in the first decade of the twenty-first century.”⁶ A recapitalization funding surge does not appear in current plans. Finally, the U. S. will be challenged to anticipate, rather than react to a thinking enemy. Following the Persian Gulf War, “future adversaries may feel strongly inclined toward neutralizing or, at a minimum, blunting U. S. airpower. Such an opponent has a menu of options available, among the potentially most effective being to attack USAF bases. Taking advantage of readily available forces and technologies, it could hope to reduce the effectiveness of U. S. air operations, at least temporarily, by destroying high-value assets or disrupting sortie generation. Alternatively or in tandem, it could hope to weaken U. S. or allied resolve by creating a strategic event, an incident that is as damaging politically to the conduct of a war as loss of a major battle is operationally or militarily.”⁷ Has the U. S. adequately prepared to meet this threat? Or have gaps in air dominance developed?

Procurement Implications

Indeed the *QDR* clearly recognized the strategic importance of halting an enemy advance, and the role of air dominance in doing so. However, the “halt phase was conspicuous by its absence in the *NDP* report. The exclusion was the work of a faction opposed to giving airpower (obviously pivotal to the halt phase) too prominent a role.”⁸

Many critics will note that further budget cuts to air dominance will undermine its clearly stated strategy for national defense. Other critics will note that the changing military technology environment necessitates a “wait and see” perspective. Certainly, the “move/counter-move game between fighter and attack aircraft and antiaircraft defenses (which include radars, surface-to-air missiles, antiaircraft artillery, and interceptors/fighters) continues unabated.”⁹ Also, certainly, even more capable air defense systems, ever growing in numbers and locations, will be fielded in the future as the “capabilities of missiles on the drawing boards indicate that they will be harder to jam, more difficult to evade, and more effective against many more attackers.”¹⁰ It follows then that “evolving air defenses and offensive combat platforms using advanced electromagnetic weapon systems have significantly increased the risk of attrition to friendly forces of all types. This risk, if not countered, could threaten the ability of aerospace forces, in particular, to dominate the combat arena and carry the war to the enemy.”¹¹ Current procurement trends imply create exploitable air dominance gaps.

Defense of Thesis and Recommendations

The overall key to military success is to ensure that the assets required to ensure air dominance in the future are being adequately addressed. The objective of the attainment of air dominance should be that most countries will not enter war if they know they will lose. A U. S. with air dominance, fighting jointly, will have the best chance of winning a conventional war and thus will have the best chance of deterring conflict. This rational thought, of course, may not hold for the world’s irrational actors who may chose to seriously challenge U. S. interests both home and abroad. These “wild card” scenarios “range from the unanticipated emergence of new technological threats, to the loss of U.

S. access to critical facilities and lines of communication in key regions, to the takeover of friendly regimes by hostile parties. Taken individually, these scenarios are unlikely. But taken together, it is more likely that one or more wild cards will occur than it is that none will occur.”¹² The *QDR* notes that the projection of security rests upon two assumptions, first “that the United States will remain politically and militarily engaged in the world over the next 15 to 20 years, and (second) that it will maintain military superiority over current and potential rivals. If the United States were to withdraw from its international commitments, relinquish its diplomatic leadership, or relinquish its military superiority, the world would become an even more dangerous place, and the threats to the United States, our allies, friends, and interests would be even more severe.”

¹³ It is highly likely that should the U. S. create any weaknesses in air dominance that the enemy will find it, exploit it, and significantly decrease U. S. airpower’s effectiveness.

It is worth pondering whether the continued distribution of a “peace dividend” would cause the U. S. to cut procurement of air dominance assets to the point which would create vulnerabilities which might entice some other country to enter into conflict with the U. S. Thus, it could be possible that a “peace dividend,” or further procurement budget cuts, may make the U. S. more likely to have to go to war. The *NDP* notes “that air and space capabilities are critical to the future, but budget and program proposals do not follow suit.”¹⁴ The *QDR* adds that the “drawdown is now over, the dividend from procurement reductions has been spent, the procurement holiday must end, and investment in modernization needs to rebound. Otherwise, the technological superiority of our forces – and our ability to sustain their equipment stocks – will erode over time.”¹⁵ Air dominance is critical to the achievement of military objectives for campaign success.

The links air dominance chain must be maintained by ensuring that the procurement of major weapon systems adds to the military's ability to maintain air dominance. In his concluding comments to the *QDR*, General John M. Shalikashvili, former Chairman of the Joint Chiefs of Staff, wrote, "if our country wishes to remain a global power, we will have to retain the capability to fight and win in more than one region at a time. The credible capacity to do so may mean we never have to use it. Our challenge is to balance risk between near-term requirements and the need to prepare for the longer term. We must dominate the future battlefield, where technology will change the face of warfare, as we dominate it today."¹⁶ However, a chain is only as strong as its weakest link, and the U. S. must work hard to ensure there are no weak links in its air dominance chain. The British Navy learned this lesson at great expense prior to World War I. At that time, while Germany was building many battleships and only a few submarines, the British built battleships but did not build an adequate number of destroyers to deal with the German submarines. It had made an error in estimating its future needs. As a result, German submarines almost starved Britain. The British didn't balance their defense expenditures properly and left their shipping exposed – a weakness which was fully exploited by Germany. Likewise, the U. S. should not leave one of its own forces, or air dominance links, underfunded. As a result, given this paper's analysis, the U. S. should continually consider that peace is the dividend of defense, and should ensure the integrity of F-22 procurement, should update its SEAD asset procurement, and should invest in the assets needed for adequate air base defense.

Notes

¹ Robert Debs Heinl, Jr., *Dictionary of Military and Naval Quotations* (Annapolis: United States Naval Institute, 1966), 315.

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⁴ Alan Bloomgarden, *Modernizing US Air Power, Pivotal Capabilities, Trends, and Supporting Technologies* (Massachusetts: Commonwealth Institute, 1995), 11.

⁵ Institute for National Strategic Studies, *National Defense University: 1997 Strategic Assessment* (Washington, D. C.: Government Printing Office, 1997), xii.

⁶ Ibid., 261.

⁷ David A. Shlapak and Alan Vick, *Check Six Begins on the Ground: Responding to the Evolving Ground Threat to U. S. Air Force Bases* (California: RAND, 1995), xiii.

⁸ John T. Correll, "They Call It Transformation," *Air Force Magazine*, February 1998, 2.

⁹ Lon O. Nordeen, Jr., *Air Warfare in the Missile Age* (Washington, D. C.: Smithsonian Institution Press, 1985), 211.

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¹³ Ibid.

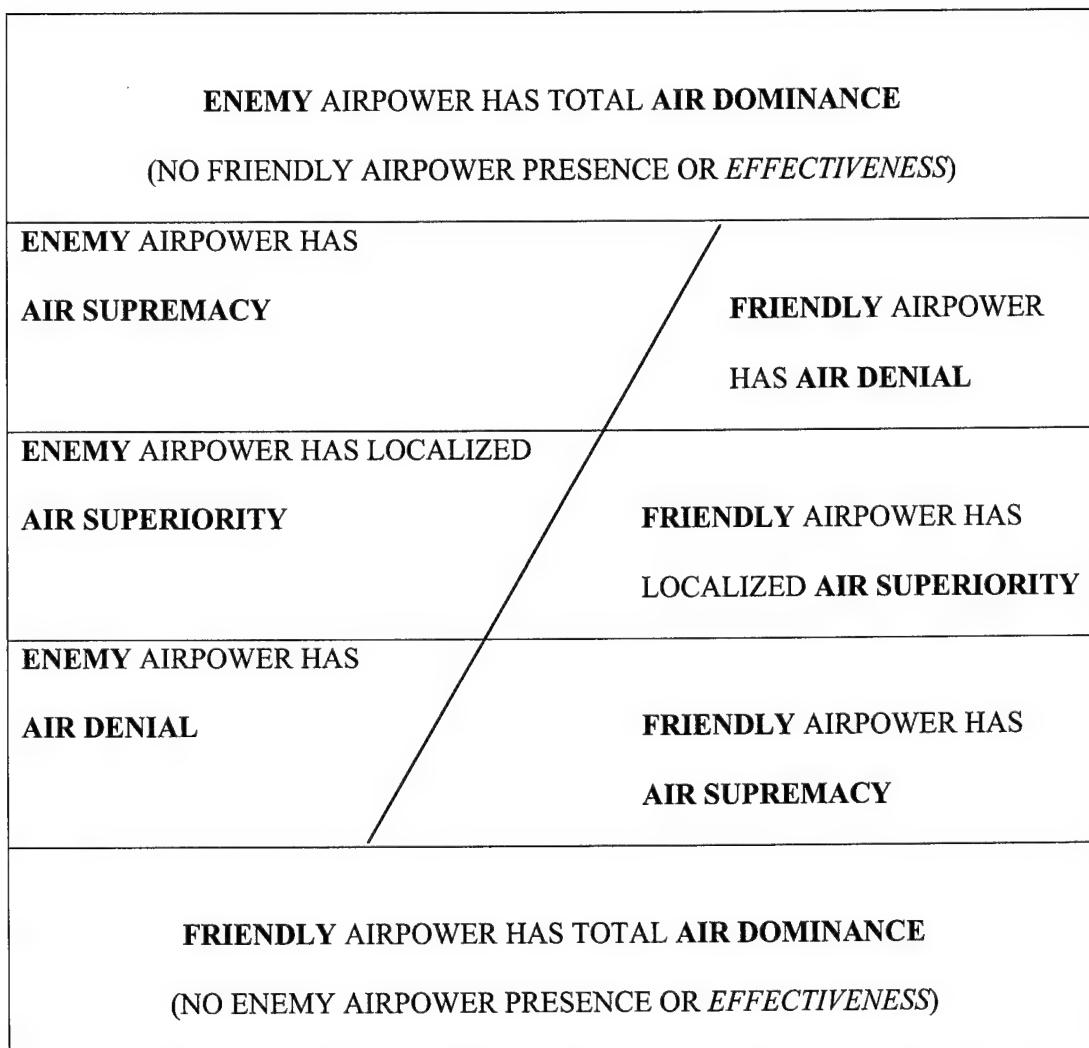
¹⁴ Correll, 2.

¹⁵ Cohen, *Secretary of Defense*, 60.

¹⁶ Ibid., 66.

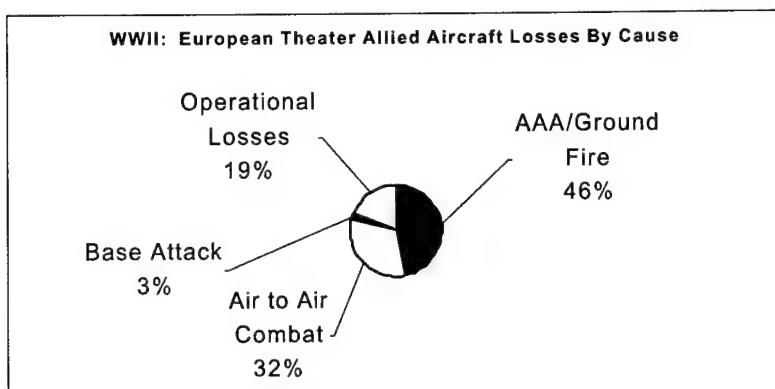
Appendix A

Scale of Airpower States



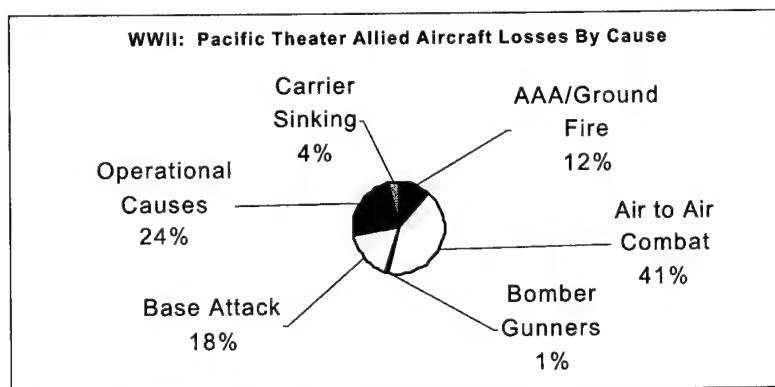
Appendix B

Aircraft Loss Causes

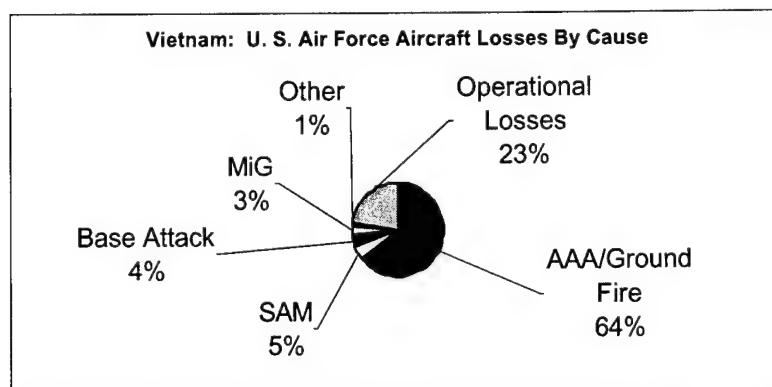


Source: Joseph H. Reinburg, *Air-To-Air Combat in World War II: A Quantitative History* (Arlington, VA.: Institute for Defense Analyses Economic and Political Studies Division, 1966), 6-16.

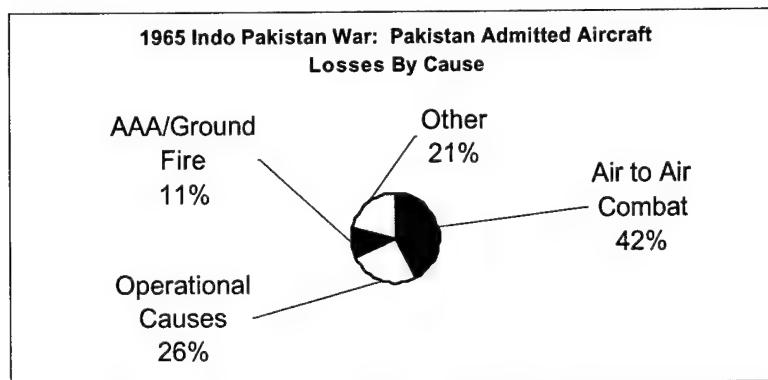
Note: Operational Losses includes losses due to mishaps and accidents.



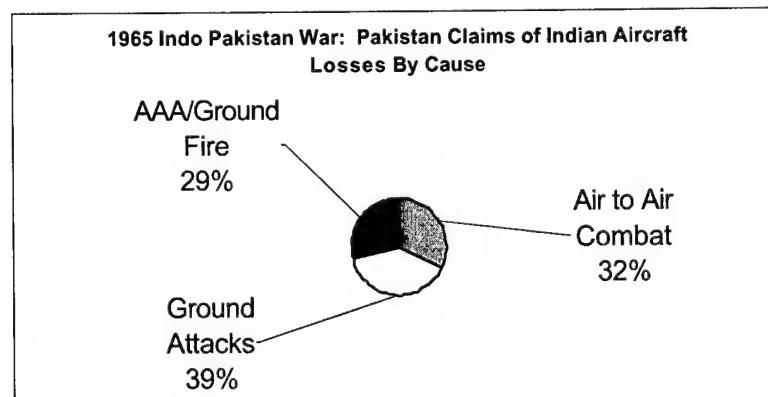
Source: Joseph H. Reinburg, *Air-To-Air Combat in World War II: A Quantitative History* (Arlington, VA.: Institute for Defense Analyses Economic and Political Studies Division, 1966), 20-40.



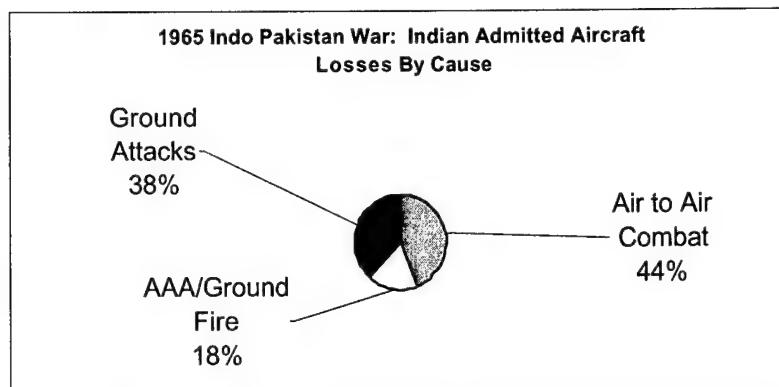
Source: John M. Granville, *Summary of USAF Aircraft Losses in SEA* (Langley AFB, VA.: Tactical Air Command Press, 1974), 24-36.



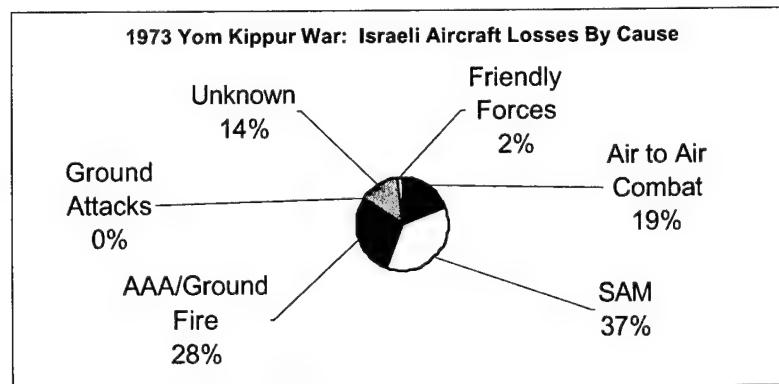
Source: John Fricker, *Battle for Pakistan: The Air War of 1965* (United Kingdom: Ian Allan Ltd., Shepperton, Surrey, 1979), 183-184



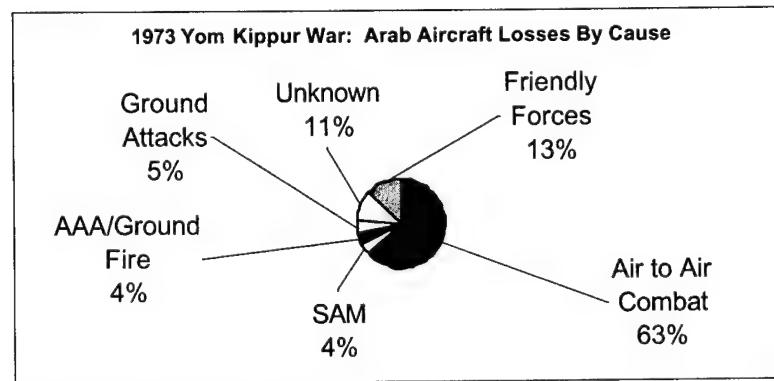
Source: John Fricker, *Battle for Pakistan: The Air War of 1965* (United Kingdom: Ian Allan Ltd., Shepperton, Surrey, 1979), 184.



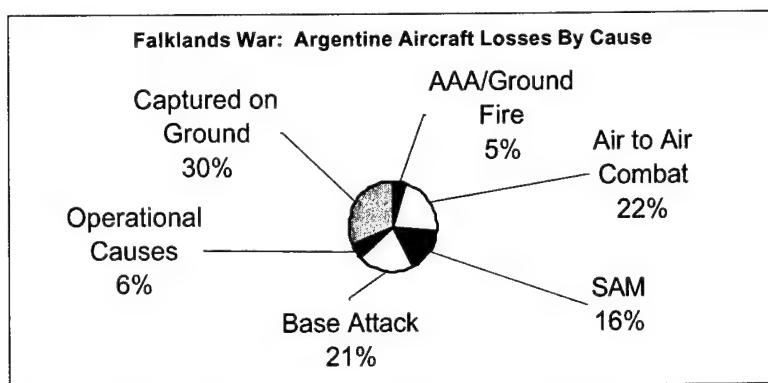
Source: John Fricker, *Battle for Pakistan: The Air War of 1965* (United Kingdom: Ian Allan Ltd., Shepperton, Surrey, 1979), 184.



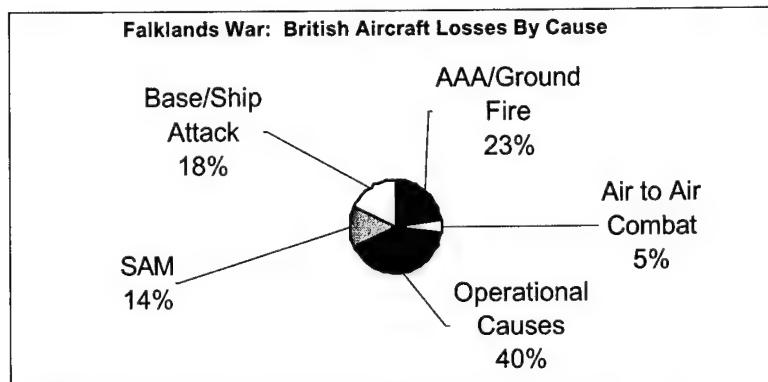
Source: Major Clarence E. Olschner, III, *The Air Superiority Battle in the Middle East, 1967-1973* (Fort Leavenworth, KS.: U. S. Army Command and General Staff College, 1978), 68.



Source: Major Clarence E. Olschner, III, *The Air Superiority Battle in the Middle East, 1967-1973* (Fort Leavenworth, KS.: U. S. Army Command and General Staff College, 1978), 68.



Source: Jeffrey Ethell and Alfred Price, *Air War South Atlantic* (New York City: Jove Books, 1983), 234-243.



Source: Jeffrey Ethell and Alfred Price, *Air War South Atlantic* (New York City: Jove Books, 1983), 248-251.

Appendix C

Desert Storm Coalition Air Dominance Assets and Tasks

Assets	Tasks
• F-117 Stealth Fighter	Performed SEAD (attack of Iraqi air defense sector operations centers, interceptor operations centers, air defense operations centers, and SAM sites.
• F-111 Aardvark	Attacked airfields, aircraft, support facilities, hardened aircraft shelters, command, control, communications and intelligence facilities, and air defense assets.
• F-15E Strike Eagle	Attacked airfields and communications facilities.
• F-16 Fighting Falcon	Attacked communications facilities, SAM sites, and airfield facilities, and launched HARMs.
• B-52 Stratofortress	Attacked communications sites, and conducted offensive counter air strikes against airfields, aircraft on the ground, airfield-supporting infrastructure, and C3 facilities.
• A-10 Thunderbolt II	Attacked electronic warfare and ground control intercept sites, and fixed SA-2/3/6 sites.
• A-6E Intruder	Attacked C3 facilities, conducted SEAD missions against SOCs and airfields, launched HARM missiles, and launched tactical air-launched decoys.
• F/A-18A/C Hornet	Conducted strikes on airfields during OCA missions, performed DCA escort sorties, and launched HARMs.
• AV-8B Harrier	Attacked airfields.
• A-7 Corsair	Attacked storage facilities.
• Tornado	Attacked hardened aircraft shelters and air base infrastructure, and launched anti-radiation missiles on SEAD missions.
• F-4G Wild Weasel	Solely conducted SEAD missions.
• EA-6B Prowler	Employed ECM equipment to jam enemy radars and communications and to deny early warning and tracking data to enemy integrated air defense systems operators by disrupting the firing solutions of enemy antiaircraft weapons. Also carried jammer pods and HARMs.
• EF-111A Raven	Provided ECM support and detection of enemy radars, stand off jamming, penetration jamming, and close-in jamming.

<u>Assets</u>	<u>Air Dominance Tasks</u>
• EC-130H Compass Call	Provided ECM, surveillance of C3, jamming of tactical air, AAA, SAMs, and battlefield communications.
• E-3 Sentry AWACS	Provided airborne warning and control.
• E-2C Hawkeye	Provided airborne warning and control.
• TR-1/U-2R	Provided high-altitude tactical reconnaissance.
• RC-135V/W Rivet Joint	Provided collection capability.
• E-8 JSTARS	Joint Surveillance Target Attack Radar System for providing surveillance and targeting information.
• BQM-74	Provided drone decoy.
• TALD	Provided drone decoy.
• F-15C Eagle	Provided air superiority to include fighter sweep, combat air patrol, escort, and HVA protection.
• F-14 Tomcat	Provided air superiority to include fighter sweep, combat air patrol, escort, and HVA protection.
• Tornado F3/ADV	Provided air superiority to include fighter sweep, combat air patrol, escort, and HVA protection.
• Mirage 2000	Provided air-superiority to include fighter sweep, combat air patrol, escort, and HVA protection. ¹

Notes

¹ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume IV, Weapons, Tactics, and Training, and Space Operations* (Washington, D. C.: Government Printing Office, 1993), 40-109.

Appendix D

Desert Storm Objectives and Phasing

Political Objectives:

- The complete, immediate, and unconditional withdrawal of Iraqi forces from Kuwait.
- Restoration of Kuwait's legitimate government.
- Protection of American citizens abroad.
- Promoting the security and stability of the Persian Gulf.

Additional Constraints:

- Minimize Coalition casualties and collateral damage from military operations.
- Discourage Israeli military involvement.

Resulting Military (Operational Campaign) Objectives:

- Attack Iraq's political-military leadership and C2 (command and control).
- Gain and maintain control of the air.
- Cut Iraqi supply lines.
- Destroy Iraq's chemical, biological, and nuclear capabilities.
- Destroy Republican Guard forces in the KTO.
- Liberate Kuwait City with Arab forces.¹

Phasing of CENTCOM's Air Campaign Plan for Operation Desert Storm:

- First, or Strategic Phase: Destroy Iraq's integrated air defense system, gain air superiority over the Iraqi air force, destroy Iraq's strategic offensive capabilities (nuclear, biological and chemical weapons and production facilities, and SCUD tactical ballistic missiles, launchers, and production capabilities), and disrupt Iraqi command, control and communications to its armed forces.
- Second, or KTO SEAD Operations Phase: Suppress Iraqi air defenses in the KTO to provide freedom of action in the air.
- Third, or Operation Campaign in the KTO Phase: Attack Iraqi Regular Army and Republican Guards in the KTO.
- Fourth Phase: Support for the Ground Campaign.²

Notes

¹ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume II, Operations, and Effects and Effectiveness* (Washington, D. C.: Government Printing Office, 1993), 273.

² Les Aspin and William Dickinson, *Defense For a New Era: Lessons of the Persian Gulf War* (Washington, D. C.: Government Printing Office, 1992), 86-87.

Appendix E

Desert Storm Iraqi Antiaircraft Weapons

<u>Iraqi Antiaircraft Weapons</u>	<u>Description</u>	<u>Effective Range</u>
• 14.5mm ZPU-1, 2, 4	Light AAA	5,000 feet
• 23mm twin/ZSU-23-4	Light AAA	15,000 feet
• 37mm	Medium AAA	10,000 feet
• 57mm S-60/ZSU-57-2	Medium AAA	20,000 feet
• 85mm KS-12	Heavy AAA	25,000 feet
• 100 mm KS-19M2	Heavy AAA	36,000 feet
• 130mm KS-30	Heavy AAA	50,000 feet
• SA-7 Grail	Manportable SAM (IR)	3.5 nm
• HN-5A	Manportable SAM (IR)	3.0 nm
• SA-9 Gaskin	Mobile SAM (IR)	4.3 nm
• SA-13 Gopher	Mobile SAM (IR)	6.0 nm
• SA-14 Gremlin	Manportable SAM (IR)	4.0 nm
• SA-2 Guideline	Cmd Guidance SAM	25.0 nm
• SA-3 Goa	Cmd Guidance SAM	18.0 nm
• SA-4 Ganef	Cmd Guidance SAM	50.0 nm
• SA-6 Gainful	Semi-Active SAM	19.0 nm
• SA-8 Gecko	Cmd Guidance SAM	7.5 nm
• Roland	Cmd Guidance SAM	4.3 nm ¹

Note: One source notes that Iraqi antiaircraft weapons included at least 4000 air defense guns and 350 long-range SAMs.² Another source notes that Iraqi antiaircraft weapons included 972 AAA sites, 2,404 Guns, and 6,100 Mobile Guns. IR SAMs totaled 6,500 SA-7s, 400 SA-9s, 192 SA-13s, and 288 SA-14s.³

Notes

¹ James P. Coyne, *Airpower in the Gulf* (Virginia: Aerospace Education Foundation, 1992), 82.

² Frank Chadwick and Matt Caffrey, *Gulf War Fact Book* (Bloomington, IL: GDW, Inc., 1991), 68.

³ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume II, Operations, and Effects and Effectiveness* (Washington, D. C.: Government Printing Office, 1993), 82.

Appendix F

Desert Storm Iraqi Air Order of Battle

<u>Iraqi Aircraft Designation</u>	<u>Type</u>	<u>Numbers</u>
• MiG-29 Fulcrum	Fighter	40-80
• MiG-25 Foxbat	Fighter	18
• MiG-23 Flogger	Fighter	20
• MiG-21 Fishbed	Fighter	105
• F-7 (Su-7 Fitter predecessor)	Fighter	20
• MiG-17 Fresco	Fighter/Attack	30
• Su-25 Frogfoot	Attack	20
• Su-20 Fitter	Attack	30
• Su-7 Fitter	Attack	50
• F-6 (MiG-19 Farmer copy)	Attack	20
• Hawker Hunter	Attack	30
• Su-24 Fencer	Bomber	10
• Mirage F-1	Bomber	100
• MiG-23/27 Flogger	Bomber	70
• Il-28	Bomber	10
• Tu-22 Blinder	Bomber	7
• Tu-16 Badger	Bomber	12
• MiG-25 Foxbat	Reconnaissance	18
• Il-75	Surveillance & Ctrol	2
• An-2	Tanker	4
• Various	Transports	80 ¹

Notes

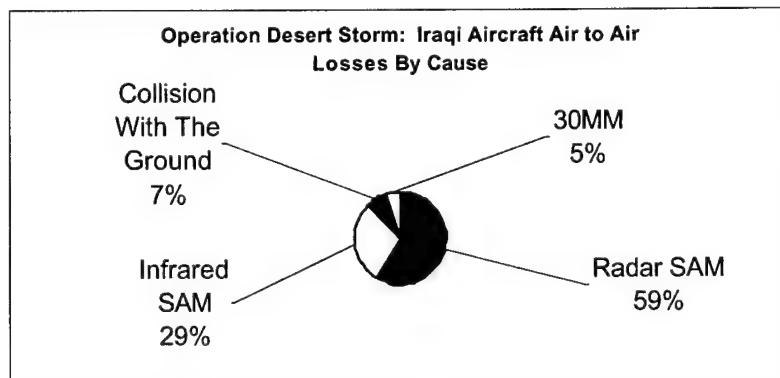
¹ Frank Chadwick and Matt Caffrey, *Gulf War Fact Book* (Bloomington, IL: GDW, Inc., 1991), 67.

Appendix G

Desert Storm Aircraft Attrition

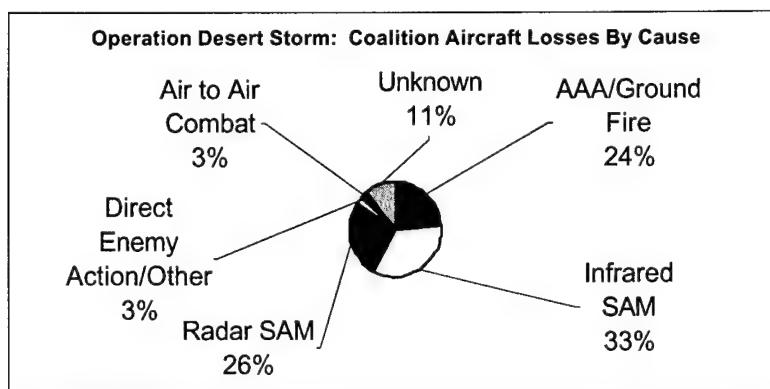
Coalition Air-To-Air Kill Matrix of Iraqi Aircraft:

• AIM – 7 (Radar SAM)	24 kills
• AIM – 9 (Infrared SAM)	12 kills
• Collision with the Ground	3 kills
• <u>30 MM</u>	<u>2 kills</u>
TOTAL	41 kills¹



Coalition Aircraft Combat Attrition Totals By Cause:

• AAA	9 Lost Aircraft	23 Damaged Aircraft
• Infrared SAM	13 Lost Aircraft	15 Damaged Aircraft
• Radar SAM	10 Lost Aircraft	4 Damaged Aircraft
• Direct Enemy Action – Other	1 Lost Aircraft	1 Damaged Aircraft
• MIG-25	1 Lost Aircraft	0 Damaged Aircraft
• Unknown	4 Lost Aircraft	4 Damaged Aircraft
• <u>Small Arms</u>	<u>0 Lost Aircraft</u>	<u>1 Damaged Aircraft</u>
TOTAL	38 Lost Aircraft	48 Damaged Aircraft²



Notes

¹ Eliot A. Cohen, ed., *Gulf War Air Power Survey, Volume V, A Statistical Compendium and Chronology* (Washington, D. C.: Government Printing Office, 1993), 653.

² Ibid., 641-649.

Appendix H

Military Expenditures Statistics

Source/Country	United States	Russia	China	Iran
<u>SIPRI Yearbook</u> <u>1997 (using 1990</u> <u>U. S. \$</u> <u>standardized)</u> ¹	<u>1990: \$306,170M</u> <u>1996: \$226,369M</u> Result: <u>Decrease of</u> <u>26%</u> for military expenditures	(U. S. \$ Info not available - inflation) Rubles Result: '92-'96 <u>Increase of 92,000%</u> for military expenditures	<u>1990: \$6,603M</u> <u>1996: \$8,162M</u> Result: <u>Increase of</u> <u>35%</u> for military expenditures	<u>1990: \$14,831M</u> <u>1996: \$18,231M</u> Result: <u>Increase of</u> <u>23%</u> for military expenditures
<u>The Military</u> <u>Balance 1997/98</u> ²	<u>1996: \$267,400M US</u> <u>1998: \$250,700M US</u> Result: <u>Decrease of</u> <u>6.24%</u> for military expenditures	<u>1993: 3,116B rubles</u> <u>1997: 104,300B rubles</u> Result: <u>Increase of</u> <u>3200%</u> for military expenditures	<u>1996: \$8.6B US</u> <u>1997: 9.7B US</u> Result: <u>Increase of</u> <u>13%</u> for military expenditures	<u>1996: \$3.4B US</u> <u>1997: \$4.7B US</u> Result: <u>Increase of</u> <u>40%</u> for military expenditures
<u>World Military</u> <u>Expenditures and</u> <u>Arms Transfers</u> <u>1996</u> ³	<u>1995: Military</u> expenditures totaled <u>3.8%</u> of gross domestic product	<u>1995: Military</u> expenditures totaled <u>11.4%</u> of gross domestic product	<u>1995: Military</u> expenditures totaled <u>5.0%</u> of gross domestic product	<u>1995: Military</u> expenditures totaled <u>2.6%</u> of gross domestic product

Notes

¹ Stockholm International Peace Research Institute, *SIPRI Yearbook 1997: Armaments, Disarmament and International Security* (Great Britain: Oxford University Press, 1997), 189, 191, 195-197.

² The International Institute for Strategic Studies, *The Military Balance: 1997/98* (London: Oxford University Press, 1997), 13-14, 104, 117, 167.

³ U. S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers 1996* (Washington, D. C.: Government Printing Office, 1997), 39.

Appendix I

Russian Inventory Fixed Wing Assets

Fixed Wing Assets	Role	Quantity/In Service
• MiG-21MF/bis/UTI	Interceptor	5000/None Claimed
• MiG-23MLD/UM	Interceptor	4500/1300+
• MiG-25PD/RB/PU	Interceptor/Recon	1000/450
• MiG-27M/D/K	Ground Attack	700/600
• MiG-29UB	Interceptor/CAS	1200/1000
• MiG-31	Interceptor	500/325
• Su-17M/UM	Ground Attack/Recon	500/Not Available
• Su-24MP/MR	Ground Attack/Recon	550/375
• Su-25BM/UB/UBK	Ground Attack	530/277
• Su-27/UB	Interceptor	350/340
• Su-30MK (Su-27PU)	Airborne Command Post	10/5
• Su-34 (Su-25TM)	Ground Attack	8/8
• Su-35	Multi-Role Fighter	10/10
• Tu-160	Strat Bomber/Recon	155/140
• Tu-22	Strat Bomber/Recon/ELINT	75/Not Available
• Tu-22M	Strat Bomber	125/120
• Tu-95K/M	Strat Bomber	50/Not Available
• Tu-95MS	Strat Bomber	85/70
• Tu-160	Strat Bomber	40/20
• Yak-28	EW	50/Not Available
• IL-20	EW	20/20
• IL-22	Airborne Cmd Post	Not Avail/Not Avail
• IL-62	Airborne Cmd Post	2/2
• IL-76MA	Airborne Cmd Post	5/5
• Beriev A-50	AWACS	12/12 ¹

Note: This list primarily includes air dominance assets and does not include transport, tankers, and trainers. There are several additional types of aircraft which are in storage or of unknown status which are not included in this list.

Notes

¹ Jane's Information Group, *Jane's Sentinel, Russia and the CIS, 1996 Edition* (United Kingdom: Sentinel House, 1996), 8.12.12.

Appendix J

Russian Inventory Air Defense Systems

<u>Air Force Air Defense Systems</u>	<u>Role</u>	<u>Quantity/In Service</u>
• Stela-3 (SA-14)	Manportable SAM	Not Avail/Not Avail
• Igla-1 (SA-16)	Manportable SAM	Not Avail/Not Avail
• S-75 Divina (SA-2)	Low/High Alt SAM	2000/Not Avail
• Almaz Pechora-M (SA-3)	Low/Med Alt SAM	1200/Not Avail
• Antey (SA-5)	Low/High Alt SAM	1900/Not Avail
• Almaz S-300 (SA-10)	Low/High Alt SAM	2400/Not Avail ¹

<u>Army Air Defense Systems</u>	<u>Role</u>	<u>Quantity/In Service</u>
• Strela-2/2M (SA-7)	Manportable SAM	5000/5000
• Strela-3 (SA-14)	Manportable SAM	2500/2500
• Igla-1 (SA-16)	Manportable SAM	500/500
• Igla (SA-18)	Manportable SAM	500/500
• 2K12 (SA-6)	Low/Med Alt SAM	400/400
• Antey 9K33 (SA-8)	Low Alt SAM	400/400
• Strela-1 (SA-9)	Low Alt SAM	275/275
• Buk (SA-11)	Low/High Alt SAM	200/200
• Antey S-300V (SA-12)	Low/High Alt SAM	40/40
• Strela-10 (SA-13)	Low Alt SAM	350/350
• Antey Tor (SA-15)	Low/Med Alt SAM	100/100
• 9M311/2S6 (SA-19)	Air Defense System	75/75
• 85mm D-44	AAA	240/240
• 57mm S-60	AAA	500/500
• 23mm ZSU-23	Light AAA	Not Avail/400
• 23mm ZSU-23-4	Quad Self-Prop AAA	Not Avail/1500 ²

Notes

¹ Jane's Information Group, *Jane's Sentinel, Russia and the CIS, 1996 Edition* (United Kingdom: Sentinel House, 1996), 8.12.20.

² *Ibid.*, 8.11.16.

Appendix K

Russian's Air Dominance Procurement Trends

Note: Despite funding problems, a combination of central funding and hopes of export opportunities have permitted the maintenance of an ambitious range of new projects, including:

- The MiG-29M interim counter-air fighter.
- The Su-35 interim multi-role air superiority fighter with 2-D thrust vectoring.
- The MiG-MAPO 1.42 advanced air superiority fighter, intended to be operational by 2005-8 (*designed to match the advance in fighter technology represented by the Lockheed F-22*).
- The Su-27IB long-range fighter-bomber, currently undergoing flight testing and pre-series production.
- The Sukhoi T-60S multi-role strategic bomber, to replace all Tu-22M and Su-24 aircraft.¹

Notes

¹ Jane's Information Group, *Jane's Sentinel, Russia and the CIS, 1996 Edition* (United Kingdom: Sentinel House, 1996), 8.15.7.

Appendix L

Chinese Inventory Fixed Wing Assets

<u>Fixed Wing Assets</u>	<u>Role</u>	<u>Quantity/In Service</u>
• H-6 (C-601)	Medium Bomber	20/20
• H-6 (Unmodified)	Medium Bomber	100/100
• H-5 (C-801)	Light Bomber	50/50
• H-5	Light Bomber	300/300
• Su-27	Interceptor	27/27
• Q-5A	Close Air Support	500/500
• J-8II	Fighter	100/100
• J-7	Fighter	500/500
• J-6 (Various)	Fighter	3200/3000
• J-5 (Various)	Fighter	400/400
• HZ-5	Long-Range Recon	50/50
• JZ-5	Battlefield Recon	140/140
• JZ-6	Battlefield Recon	120/120
• EY-8	Intelligence Gatherer	18/18
• Tu-154M	Electronic Warfare	2/2 ¹

Note: This list primarily includes air dominance assets and does not include transport, tankers, and trainers. There are several additional types of aircraft which are in storage or of unknown status which are not included in this list.

Notes

¹ Jane's Information Group, *Jane's Sentinel, China and Northeast Asia, 1997 Edition* (United Kingdom: Sentinel House, 1997), 1.12.11.

Appendix M

Chinese Inventory Air Defense Systems

<u>Air Defense Systems</u>	<u>Role</u>	<u>Quantity/In Service</u>
• S-300	Air Defense System	Not Avail/Not Avail
• HQ-61	Air Defense System	48/48
• HQ-2J	Air Defense System	24/24
• HQ-2B	Air Defense System	36/36
• 100mm	AAA	Not Avail/Not Avail
• 85mm	AAA	Not Avail/Not Avail
• 57mm	AAA	Not Avail/Not Avail
• 35mm	AAA	Not Avail/Not Avail
• 14.5mm	AAA	Not Avail/Not Avail
• 12.7mm	AAA	Not Avail/Not Avail ¹

Notes

¹ Jane's Information Group, *Jane's Sentinel, China and Northeast Asia, 1997 Edition* (United Kingdom: Sentinel House, 1997), 1.12.13.

Appendix N

China's Air Dominance Procurement Trends

China's key mission areas and weapons systems for future development:

- Developing anti-submarine warfare, ship-borne air defense, sustained naval operations, and amphibious warfare capabilities.
- Developing strategic airlift, aerial refueling, ground-attack capabilities, and a new generation of air-superiority fighters.
- Improving ground force mobility and logistical support, air defense, all-weather operations, and command-and-control capabilities.¹

1993-1997 Air Dominance Conventional Weapons Orders and Deliveries:

- One EL/M-2075 Phalcon AEW radar system from Israel.
- 72 Su-27 Flanker fighter aircraft from Russia with a licensed production for approximately 150 more Su-27s.
- Four SA-10b SAM systems from Russia.
- 288 AA-11 Archer air-to-air missiles for Su-27 fighters from Russia.
- 192 SA-10 Grumble SAM systems from Russia.
- Eight MPA Searchwater AEW radars from the United Kingdom.
- 144 AA-10a Alamo air-to-air missiles for Su-27 fighters from Ukraine.
- Four IL-76 AEW aircraft from Russia.
- 300 FGA F-10 fighter aircraft from domestic development.
- Three IL-78 tanker aircraft from Russia.
- 28 Mi-17 Helicopters from Russia.^{2 3 4}

Notes

¹ Institute for National Strategic Studies, *National Defense University: 1997 Strategic Assessment* (Washington, D. C.: Government Printing Office, 1997), 50.

² Jane's Information Group, *Jane's Sentinel, China and Northeast Asia, 1997 Edition* (United Kingdom: Sentinel House, 1997), 1.15.10.

Notes

³ The International Institute for Strategic Studies, *The Military Balance: 1997/98* (London: Oxford University Press, 1997), 170.

⁴ Stockholm International Peace Research Institute, *SIPRI Yearbook 1997: Armaments, Disarmament, and International Security* (Great Britain: Oxford University Press, 1997), 302.

Appendix O

Iran's Inventory Fixed Wing Assets

<u>Fixed Wing Assets</u>	<u>Role</u>	<u>Quantity/In Service</u>
• H-6D	Bomber	6/6
• Tu-22M	Bomber	4/4
• F-7M	Combat Aircraft	65/65
• Mirage F-1EQ	Multi-Role Fighter	12/12
• F-14A	Interceptor Fighter	30/30
• F-4D/E	Multi-Role Fighter	50/50
• MiG-23BN	Combat Aircraft	24/24
• MiG-27	Strike Aircraft	24/24
• MiG-29	Combat Aircraft	48/48
• MiG-29UB	Combat Aircraft	18/18
• F-5E	Combat Aircraft	65/65
• F-5F	Combat Aircraft	8/8
• FT-7	Combat Aircraft	5/5
• F-6	Combat Aircraft	20/20
• Su-20	Combat Aircraft	2/2
• Su-22M	Combat Aircraft	35/35
• Su-24MK	Combat Aircraft	20/20
• Su-25	Ground Attack Aircraft	7/7 ¹

Note: This list primarily includes air dominance assets and does not include transport, tankers, and trainers. There are several additional types of aircraft which are in storage or of unknown status which are not included in this list.

Notes

¹ Jane's Information Group, *Jane's Sentinel, The Gulf States, 1997 Edition* (United Kingdom: Sentinel House, 1997), 2.12.8.

Appendix P

Iran's Inventory Air Defense Systems

<u>Air Defense Systems</u>	<u>Role</u>	<u>Quantity/In Service</u>
• I-HAWK	SAM System	150/150
• Rapier	Low Alt SAM	20/20
• HQ-2J	Low/High Alt SAM	60/55
• Antey (SA-5)	Med Alt SAM	Not Avail/Not Avail
• Sk12 (SA-6)	Med Alt SAM	Not Avail/Not Avail
• 57mm SZ-60	Automatic AAA	50/35
• 40mm M1	Automatic AAA	40/20
• 40mm L/70	Automatic AAA	100/95
• 23mm ZU-23-2	Twin Air Defense AAA	250/250 ¹

Notes

¹ Jane's Information Group, *Jane's Sentinel, The Gulf States, 1997 Edition* (United Kingdom: Sentinel House, 1997), 2.12.10.

Appendix Q

Iran's Air Dominance Procurement Trends

1989-1997 Air Dominance Conventional Weapons Orders and Deliveries:

- 100 Igla manportable SAMs from Russia.
- 100 Strela 3 manportable SAMs from Russia
- 12 Mi-17 utility helicopters from Russia.
- 78 MiG-29 combat aircraft from Russia.
- Unknown number of Mi-24 attack helicopters from Russia.
- 24 Su-24MK strike aircraft from Russia.
- Unknown number of MiG-23BN combat aircraft from Ukraine.
- Unknown number of MiG-27 combat aircraft from Russia.
- 52 HQ-2B SAM systems from China.¹

Additional Notes: The 1989 deal with Moscow apparently “included 48 MiG-29s, about 35 of which were supplied to Iran by 1994. In July 1991 another large air force transaction was concluded with Moscow, which probably involved 48 more MiG-29s and 24 MiG-31s, as well as 24 Sukhoi-24s and possibly 24 MiG-27s (and according to some information, 24 Sukhoi-27s as well). To this one may add 12 Tu-22M long-range bombers, two IL-76 early warning aircraft, and spare parts for the 115 Iraqi combat aircraft that fled to Iran during the Second Gulf War, and which were grounded due to a shortage of spare parts and ammunition.”² Missile capabilities have also received the highest priority as “Iran remains the major regional source for concern with regard to ballistic- and cruise-missile proliferation and associated WMD programs. Russia is reported to have supplied Iran with SS-4 missile-related equipment and possibly civil

nuclear-power technology in late 1996. Iran is also believed to have acquired technology from North Korea for the Scud-derivative Nodong surface-to-surface missile (SSM) and to be involved in a cooperative program with Pyongyang to improve the Nodong. Iran continues to develop the C-801 cruise missile.”³ Missile program capabilities now include “nine SAM sites with SA-5, SA-6, and HAWK missiles; and some 35 ballistic missile sites with over 400 SCUD Cs, Bs, and SS-8s. Iran’s ballistic missiles are capable of reaching all of Bahrain, Kuwait, the UAE, Qatar, the Gulf coast of Saudi Arabia, and northern Oman.”⁴

Notes

¹ Jane’s Information Group, *Jane’s Sentinel, The Gulf States, 1997 Edition* (United Kingdom: Sentinel House, 1997), 2.15.10.

² Shlomo Gazit and Zeev Eytan, *The Middle East Military Balance* (Jerusalem: Tel Aviv University Jaffee Center for Strategic Studies, 1994), 83.

³ The International Institute for Strategic Studies, *The Military Balance: 1997/98* (London: Oxford University Press, 1997), 118-119.

⁴ Institute for National Strategic Studies, *National Defense University: 1997 Strategic Assessment* (Washington, D. C.: Government Printing Office, 1997), 90.

Appendix R

Airbase Ground Attack Study Findings

The study's findings, given the means, opportunity, and motivation of the attacking forces, are that:

- Many possible adversaries have force elements – special forces, light infantry, airborne units – capable of conducting attacks on air bases.
- Historically, small-unit attacks on air bases have had great success at harassing defenders and destroying aircraft.
- Widely available technologies, including large-caliber sniper rifles, portable surface-to-air missiles, guided mortar munitions, and GPS receivers, are making small units more survivable and more lethal.
- In particular, the standoff threat – attacks carried out from outside, perhaps well outside, the base perimeter – should grow dramatically as these new, affordable technologies are exploited.
- U. S. reliance on small numbers of high-value aircraft – JSTARS, AWACS, etc. – makes those assets tempting targets for ground attack.
- Expeditionary operations – operations away from well-developed theaters – increase the USAF's vulnerability to air base attack.¹

The “thinking enemy” might:

- Protect its vital warfighting assets and infrastructure from air attack by hardening them, hiding them, or making them mobile.
- Develop innovative operational concepts for its own air force to deflect U. S. airpower into peripheral and resource-consuming activities.
- Deploy distributed, redundant air defenses that would be less vulnerable to the kind of suppression campaign that was waged against Iraq.
- Employ ballistic and cruise missiles – with or without nuclear, biological, or chemical (NBC) warheads – to disrupt U. S. rear area operations, particularly on and around air bases.
- Employ small teams of ground forces to destroy key U. S. air assets and disrupt air base operations.²

Notes

¹ David A. Shlapak and Alan Vick, *Check Six Begins on the Ground: Responding to the Evolving Ground Threat to U. S. Air Force Bases* (California: RAND, 1995), xiii.

² *Ibid.*, 12.

Please reference *Battle for Hue: Tet, 1968* by Keith William Nolan for an account of the actions taken by two Viet Cong regiments of infantry and sappers to attack the city, and the airfield, of Hue in South Vietnam from January 31 to February 26, 1968. Also reference *Sappers in the Wire, The Life and Death of Firebase Mary Ann* by Keith William Nolan for an account of a Viet Cong sapper company which infiltrated Fire Support Base Mary Ann during the night of 27-28 March 1971.

Appendix S

Airborne/Special Forces Units of Sample Countries

Country	Airborne/Special Forces Units
China	3 Airborne Divisions
Cuba	1 Airborne Brigade
India	1 Airborne/Commando Brigade
Indonesia	3 Airborne Brigades/4 Special Forces Battalions
Iran	1 Special Forces Division
Libya	19 Commando Battalions
North Korea	22 Special Forces Brigades
Brazil	1 Airborne Brigade
Russia	5 Airborne Divisions/5 Spetsnaz Brigades
Serbia	1 Airborne Brigade
Syria	1 Special Forces Division
Ukraine	2 Airborne Brigades/2 Spetsnaz Brigades ¹

Notes

¹ David A. Shlapak and Alan Vick, *Check Six Begins on the Ground: Responding to the Evolving Ground Threat to U. S. Air Force Bases* (California: RAND, 1995), 41.

Appendix T

Top 20 USAF Acquisition Programs for Fiscal Years 1997-2003

Priority of Item	Budgeted Amount in \$ Billions U. S.
1. F-22 fighter	22.3
2. C-17 transport	21.1
3. SBIRS system	5.4
4. JSF	5.3
5. E-8 Joint Stars	4.3
6. F-15 fighter	3.6
7. Minuteman III ICBM	3.4
8. Titan booster	3.3
9. Milstar satellite	3.1
10. F-16 fighter	2.8
11. EELV booster	2.6
12. GPS Satellite	2.4
13. B-2 bomber	2.3
14. B-1B bomber	1.8
15. E-3 AWACS	1.7
16. Electronic combat	1.7
17. Airborne Laser	1.6
18. CV-22 SOF craft	1.5
19. C-130 transport	1.5
20. Advanced MILSATCOM	1.4 ¹

Notes

¹ Peter Grier, "The Material World," *Air Force Magazine*, October 1997, 52.

Appendix U

Major US Air Dominance Weapon Systems on Order/Upgrade, FY 1998-2003

Type/Equipment	Number	Comments:
• B-1B/Bomber	N/A	Upgrades
• B-2/Bomber	N/A	Previous order/development
• F-15E/Fighter	3	Acquisition
• F-16/Fighter	N/A	Upgrades
• F-22/Fighter	70	Development/production
• JSF/Fighter	N/A	Development
• E-8/Joint Stars	1	Acquisition
• AV-8B/Fighter	44	Acquisition
• F-14/Fighter	N/A	Upgrades
• F/A-18C/D Fighter	N/A	Upgrades
• F/A-18E/F Fighter	248	Acquisition ¹

Notes

¹ The International Institute for Strategic Studies, *The Military Balance: 1997/98* (London: Oxford University Press, 1997), 17.

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